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Brette et al.

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(54) **METHODS AND SYSTEMS FOR BUILDING A SEARCH SERVICE APPLICATION**

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G06F 17/30 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 17/30*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 17/30
USPC 717/104
See application file for complete search history.

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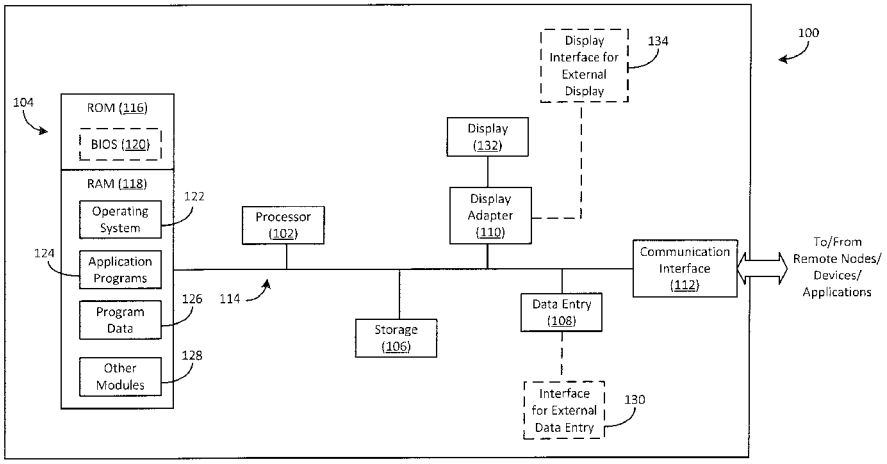
(57) **ABSTRACT**

A method for building an application is disclosed and includes receiving a request to build a search service application for a first object, where the object is associated with attributes and each attribute is associated with a value, receiving a first indication selecting an end-user input field that corresponds to a first attribute associated with the first object, and receiving a second indication selecting a search result output field that corresponds to an attribute associated with the first object. The method also includes selecting a code template from a plurality of code templates in a code library that comprises programming code for creating a search model of a search service application. Using the selected code template, the search model representing the search service application is generated based on the end-user input and the search result output fields.

20 Claims, 8 Drawing Sheets



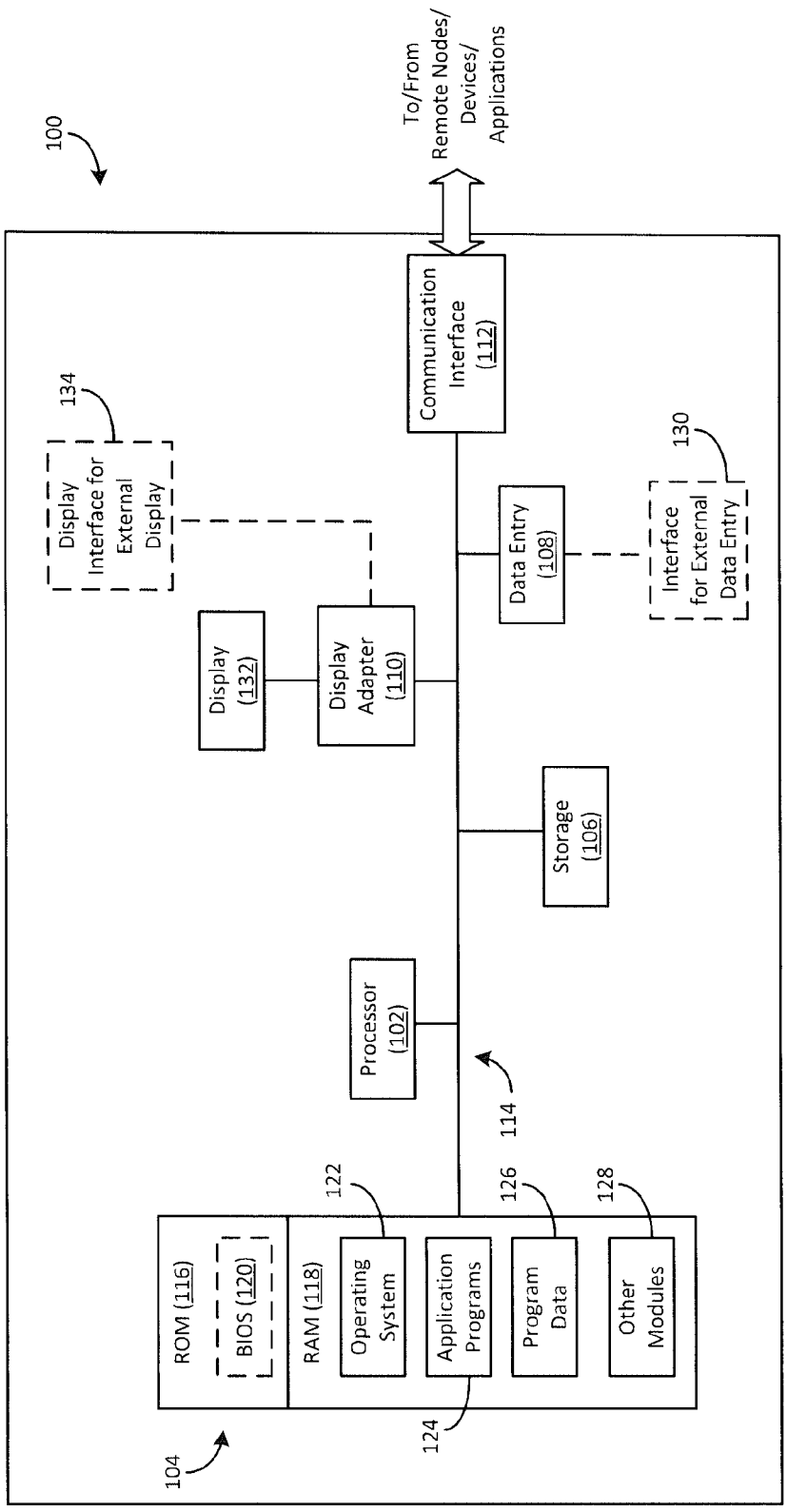

100
To/From Remote Nodes/ Devices/ Applications
Communication Interface (112)
134
Display Interface for External Display
130
Interface for External Data Entry
Data Entry (108)
Display (132)
Display Adapter (110)
Storage (106)
Processor (102)
114
122
126
128
ROM (116)
BIOS (120)
RAM (118)
Operating System
Application Programs
Program Data
Other Modules
124
104

FIG. 1

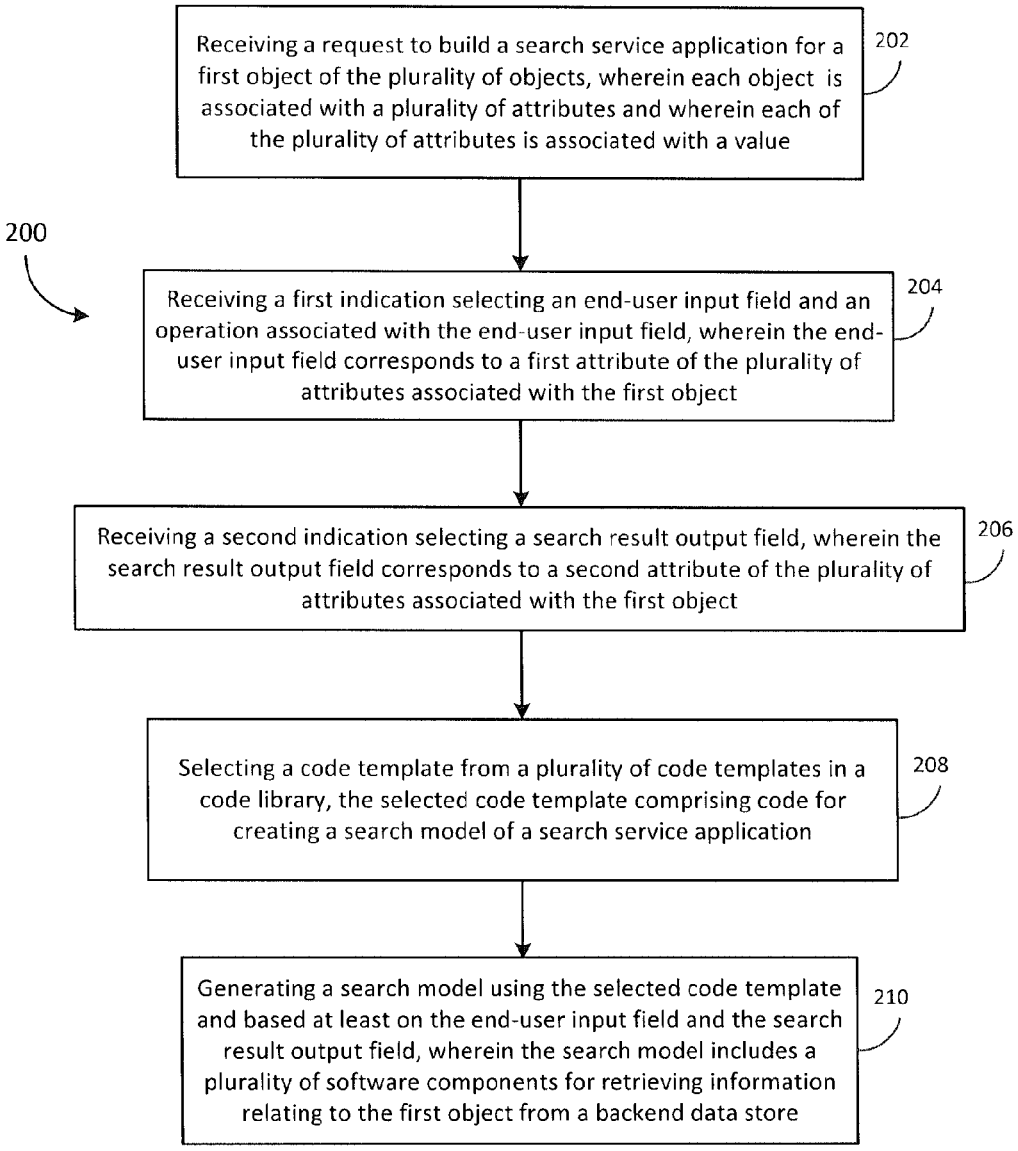

Receiving a request to build a search service application for a first object of the plurality of objects, wherein each object is associated with a plurality of attributes and wherein each of the plurality of attributes is associated with a value
202
200
Receiving a first indication selecting an end-user input field and an operation associated with the end-user input field, wherein the end-user input field corresponds to a first attribute of the plurality of attributes associated with the first object
204
Receiving a second indication selecting a search result output field, wherein the search result output field corresponds to a second attribute of the plurality of attributes associated with the first object
206
Selecting a code template from a plurality of code templates in a code library, the selected code template comprising code for creating a search model of a search service application
208
Generating a search model using the selected code template and based at least on the end-user input field and the search result output field, wherein the search model includes a plurality of software components for retrieving information relating to the first object from a backend data store
210

FIG. 2

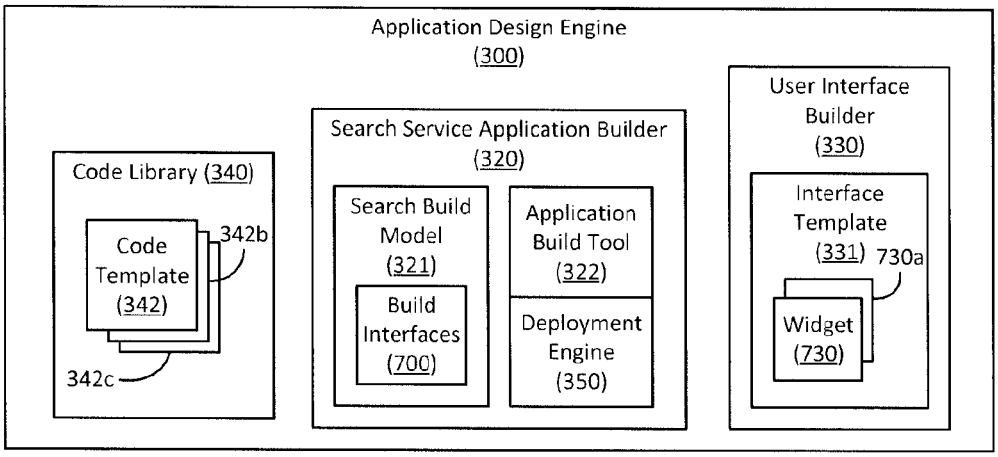

Application Design Engine
(300)
Code Library (340)
Code Template (342)
342b
342c
Search Service Application Builder (320)
Search Build Model (321)
Build Interfaces (700)
Application Build Tool (322)
Deployment Engine (350)
User Interface Builder (330)
Interface Template (331)
730a
Widget (730)

FIG. 3

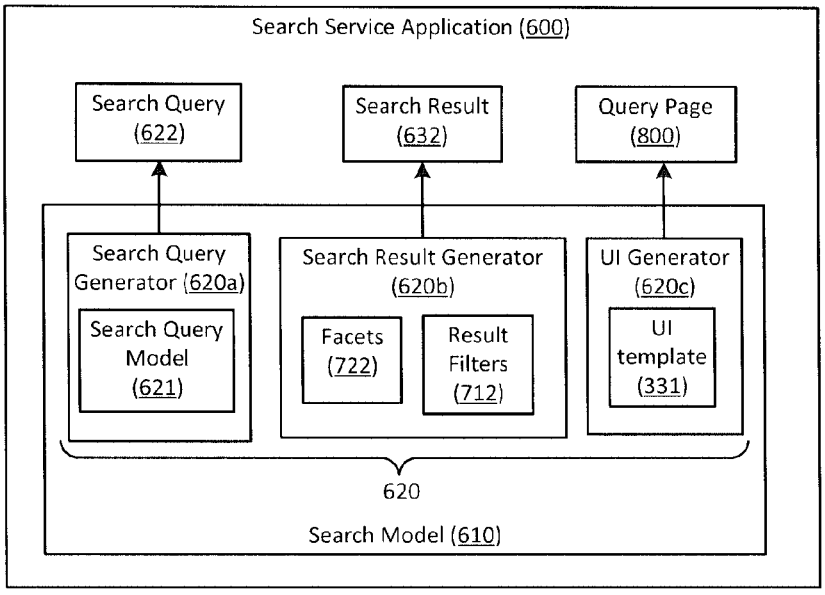

Search Service Application (600)
Search Query (622)
Search Result (632)
Query Page (800)
Search Query Generator (620a)
Search Query Model (621)
Search Result Generator (620b)
Facets (722)
Result Filters (712)
UI Generator (620c)
UI template (331)
620
Search Model (610)

FIG. 6

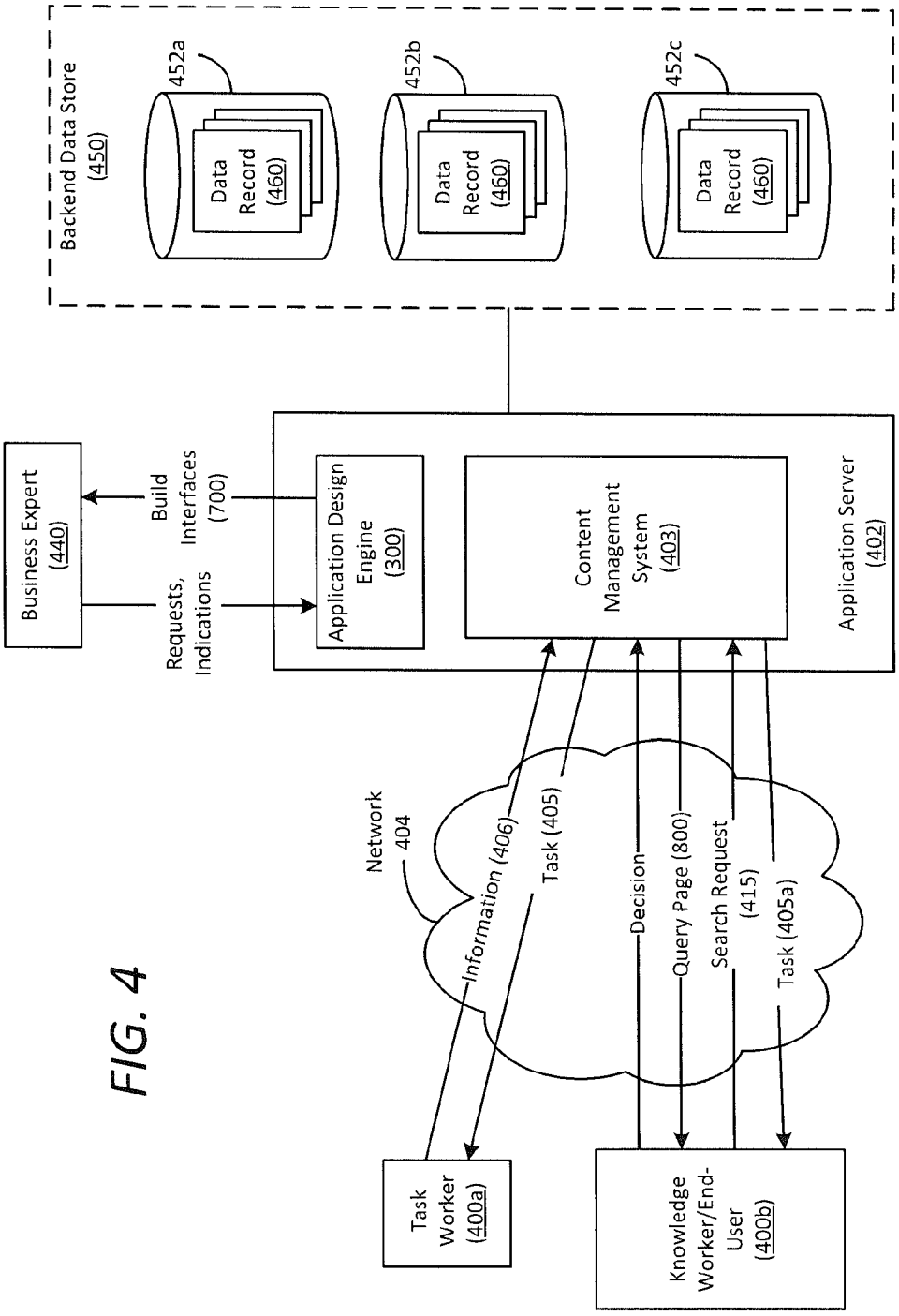

Backend Data Store (450)
452a
Data Record (460)
452b
Data Record (460)
452c
Data Record (460)
Business Expert (440)
Build Interfaces (700)
Requests, Indications
Application Design Engine (300)
Content Management System (403)
Application Server (402)
Network 404
Information (406)
Task (405)
Decision
Query Page (800)
Search Request (415)
Task (405a)
Task Worker (400a)
Knowledge Worker/End-User (400b)

FIG. 4

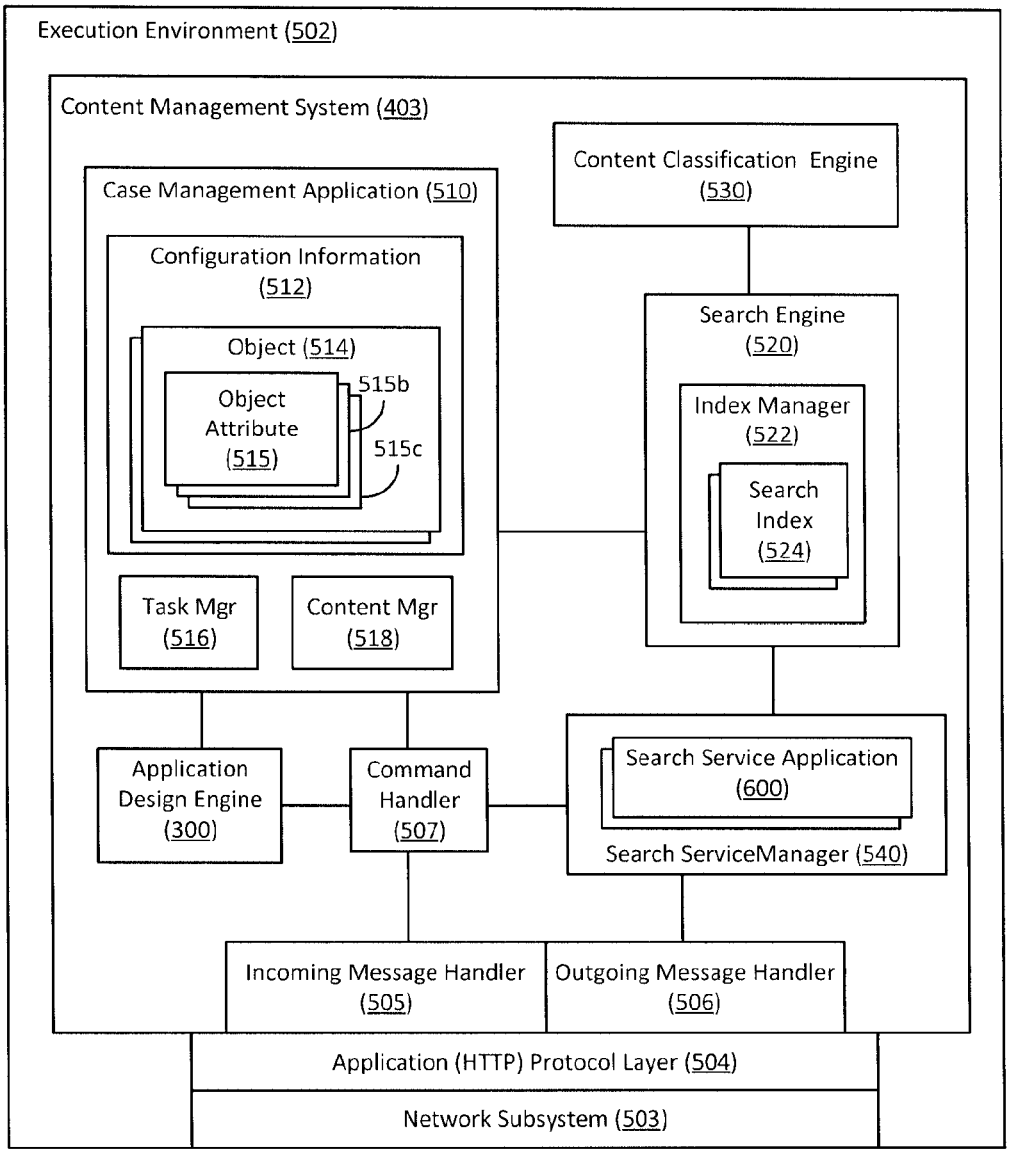
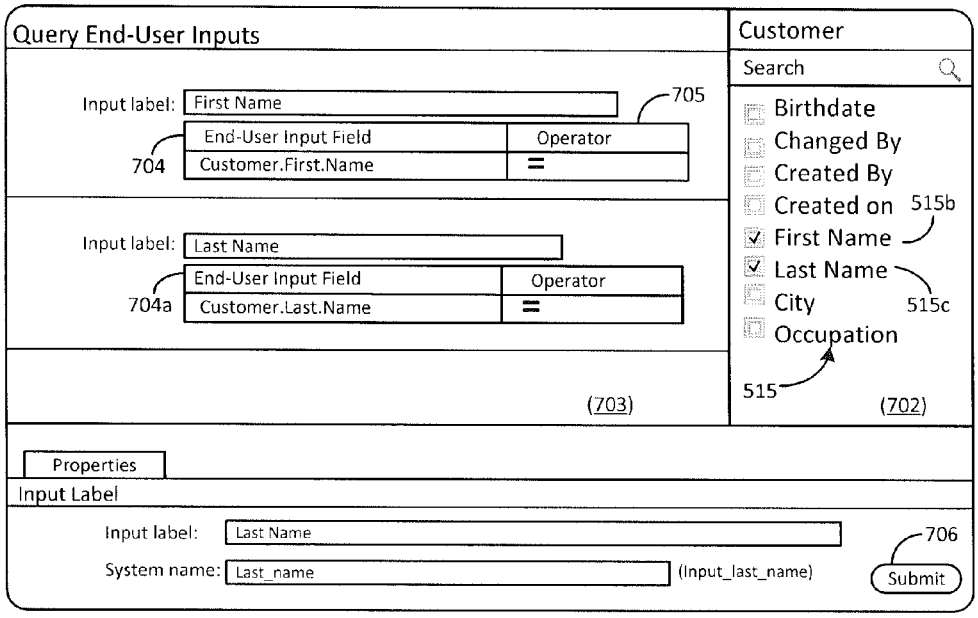
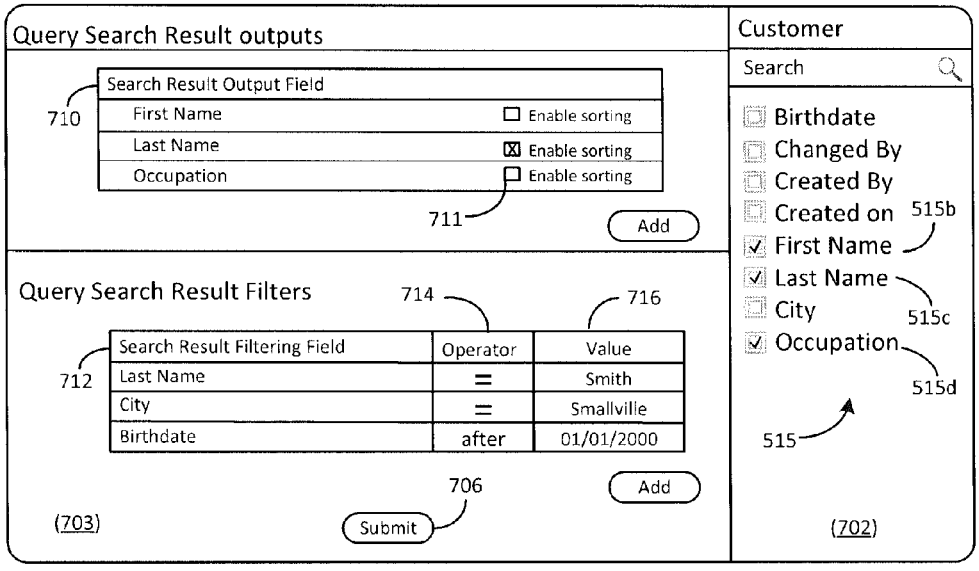

Execution Environment (502)
Content Management System (403)
Content Classification Engine (530)
Case Management Application (510)
Configuration Information (512)
Object (514)
Object Attribute (515)
515b
515c
Search Engine (520)
Index Manager (522)
Search Index (524)
Task Mgr (516)
Content Mgr (518)
Application Design Engine (300)
Command Handler (507)
Search Service Application (600)
Search ServiceManager (540)
Incoming Message Handler (505)
Outgoing Message Handler (506)
Application (HTTP) Protocol Layer (504)
Network Subsystem (503)

FIG. 5



700a

FIGURE 7A



700b

FIGURE 7B

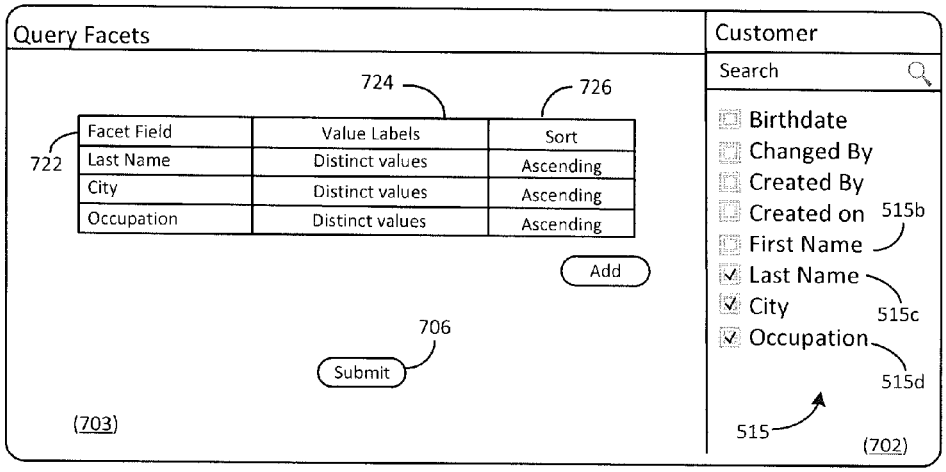


FIGURE 7C

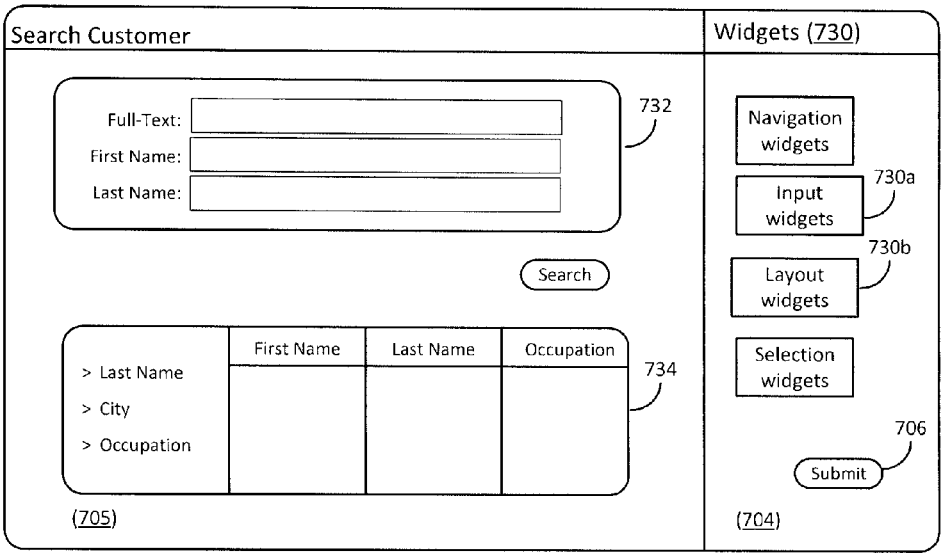
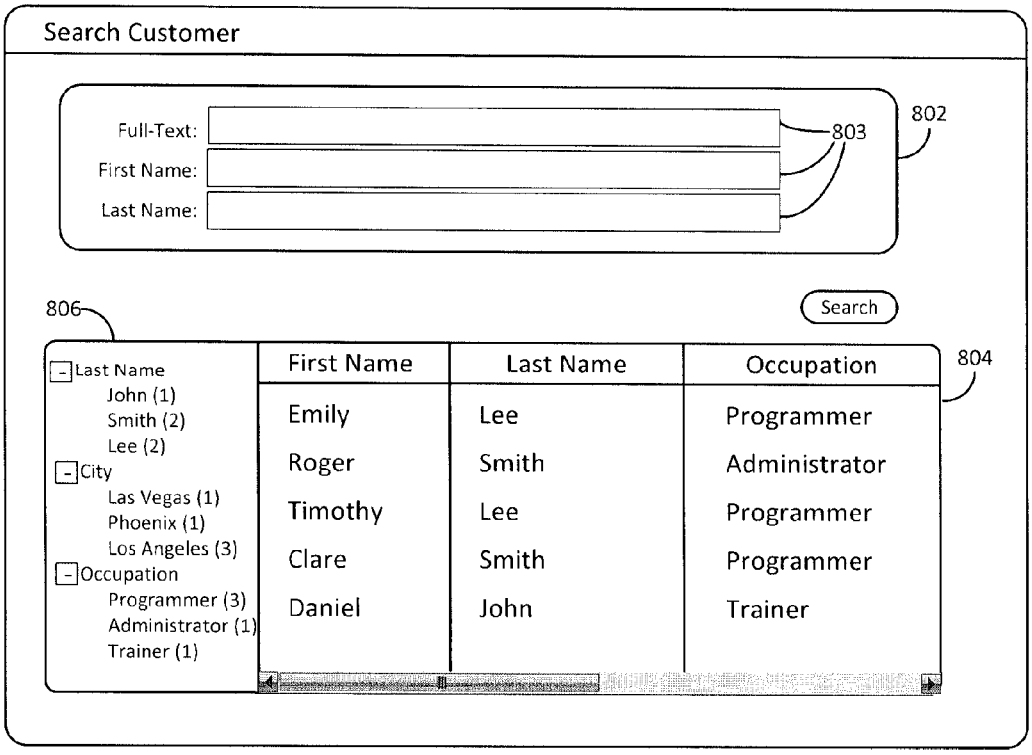


FIGURE 7D


Search Customer
Full-Text:
First Name:
Last Name:
803
802
Search
806
Last Name
John (1)
Smith (2)
Lee (2)
City
Las Vegas (1)
Phoenix (1)
Los Angeles (3)
Occupation
Programmer (3)
Administrator (1)
Trainer (1)
First Name
Last Name
Occupation
804
Emily
Lee
Programmer
Roger
Smith
Administrator
Timothy
Lee
Programmer
Clare
Smith
Programmer
Daniel
John
Trainer

800

FIGURE 8

METHODS AND SYSTEMS FOR BUILDING A SEARCH SERVICE APPLICATION

BACKGROUND

A case management application helps an enterprise to manage its business processes by providing a computer-based framework for collecting, tracking and storing business process information. For example, a case management application can assist the enterprise to collect and store case management data associated with a loan application process, an insurance claim process, and the like. In some cases, the case management application can also support data searching services that allow an end-user to search for and to retrieve case management data and/or non-enterprise related information relevant to performing a process task. In these cases, the application can be referred to as a search-based case management application.

Typically, the search-based case management application is customized to the enterprise's business process. Building such an application is complex and typically requires skilled programmers to write customized code to handle various phases of the enterprise's business process. Enabling search capabilities is particularly difficult because the programmers must build search queries for a variety of backend storage structures, must configure search indexing engines to build indexes based on the enterprise's specifications, and must configure document analyzers to annotate documents in the repository in order to make them searchable. Accordingly, the application building process for a search-based case management application is expensive and time-consuming.

To address some aspects of this issue, computer-based solutions are available that allow the enterprise's business expert to design and configure a case management application for a business process without requiring programmers to write custom code. In essence, the solution supports automated code generation based on configuration information provided by the business expert. For example, Documentum xCP Designer by EMC Corporation of Hopkinton, Mass. is a configuration-based solution that provides graphical composition tools for the business expert to design case management applications. Using a drag-and-drop graphical toolset, the business expert can model business processes, design electronic forms, and design user interfaces, from which the system can build the application.

While computer-based application building solutions can significantly reduce or eliminate the need for custom coding to build a case management application, enabling a search service within the case management application remains a manual process requiring a skilled programmer to write custom coding. Accordingly, building a search-based case management application continues to be an expensive and time-consuming process.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the subject matter claimed will become apparent to those skilled in the art upon reading this description in conjunction with the accompanying drawings, in which like reference numerals have been used to designate like elements, and in which:

FIG. **1** is a block diagram illustrating an exemplary hardware device in which the subject matter may be implemented;

FIG. **2** is a flow diagram illustrating an exemplary method for building a search service application according to an exemplary embodiment;

FIG. **3** is a block diagram illustrating an exemplary system for building a search service application according to an exemplary embodiment;

FIG. **4** is a block diagram illustrating a network in which a system for building a search service application can be implemented

FIG. **5** is a block diagram illustrating another exemplary system for building a search service application according to an exemplary embodiment;

FIG. **6** is a block diagram illustrating an exemplary search service application according to an exemplary embodiment;

FIGS. **7**A-**7**D illustrate exemplary user interfaces for building a search service application according to an exemplary embodiment; and

FIG. **8** illustrates an exemplary user interface for receiving query inputs and for providing search results according to an exemplary embodiment.

DETAILED DESCRIPTION

The subject matter presented herein provides a computer-based system for designing and building a search service application. According to an embodiment, an application design system includes a search service application builder component that provides a model configured to lead a business expert through a series of steps to design a custom search service application. In an embodiment, the model allows the business expert to select which attributes of an object can be searched and what information will be returned in a search result. The model can also enable the business expert to specify other search features, such as filters, facets, sorts and the like. When the business expert is done designing the search service application, the search service application builder component automatically provides computer code for the custom search service application based on the business expert's selections. The resulting custom search service application can then be a standalone component and/or integrated with a case management application.

Prior to describing the subject matter in detail, an exemplary hardware device in which the subject matter may be implemented shall first be described. Those of ordinary skill in the art will appreciate that the elements illustrated in FIG. **1** may vary depending on the system implementation. With reference to FIG. **1**, an exemplary system for implementing the subject matter disclosed herein includes a hardware device **100**, including a processing unit **102**, memory **104**, storage **106**, data entry module **108**, display adapter **110**, communication interface **112**, and a bus **114** that couples elements **104**-**112** to the processing unit **102**.

The bus **114** may comprise any type of bus architecture. Examples include a memory bus, a peripheral bus, a local bus, etc. The processing unit **102** is an instruction execution machine, apparatus, or device and may comprise a microprocessor, a digital signal processor, a graphics processing unit, an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), etc. The processing unit **102** may be configured to execute program instructions stored in memory **104** and/or storage **106** and/or received via data entry module **108**.

The memory **104** may include read only memory (ROM) **116** and random access memory (RAM) **118**. Memory **104** may be configured to store program instructions and data during operation of device **100**. In various embodiments, memory **104** may include any of a variety of memory technologies such as static random access memory (SRAM) or dynamic RAM (DRAM), including variants such as dual data rate synchronous DRAM (DDR SDRAM), error correcting

code synchronous DRAM (ECC SDRAM), or RAMBUS DRAM (RDRAM), for example. Memory **104** may also include nonvolatile memory technologies such as nonvolatile flash RAM (NVRAM) or ROM. In some embodiments, it is contemplated that memory **104** may include a combination of technologies such as the foregoing, as well as other technologies not specifically mentioned. When the subject matter is implemented in a computer system, a basic input/output system (BIOS) **120**, containing the basic routines that help to transfer information between elements within the computer system, such as during start-up, is stored in ROM **116**.

The storage **106** may include a flash memory data storage device for reading from and writing to flash memory, a hard disk drive for reading from and writing to a hard disk, a magnetic disk drive for reading from or writing to a removable magnetic disk, and/or an optical disk drive for reading from or writing to a removable optical disk such as a CD ROM, DVD or other optical media. The drives and their associated computer-readable media provide nonvolatile storage of computer readable instructions, data structures, program modules and other data for the hardware device **100**.

It is noted that the methods described herein can be embodied in executable instructions stored in a computer readable medium for use by or in connection with an instruction execution machine, apparatus, or device, such as a computer-based or processor-containing machine, apparatus, or device. It will be appreciated by those skilled in the art that for some embodiments, other types of computer readable media may be used which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, RAM, ROM, and the like may also be used in the exemplary operating environment. As used here, a "computer-readable medium" can include one or more of any suitable media for storing the executable instructions of a computer program in one or more of an electronic, magnetic, optical, and electromagnetic format, such that the instruction execution machine, system, apparatus, or device can read (or fetch) the instructions from the computer readable medium and execute the instructions for carrying out the described methods. A non-exhaustive list of conventional exemplary computer readable medium includes: a portable computer diskette; a RAM; a ROM; an erasable programmable read only memory (EPROM or flash memory); optical storage devices, including a portable compact disc (CD), a portable digital video disc (DVD), a high definition DVD (HD-DVD™), a BLU-RAY disc; and the like.

A number of program modules may be stored on the storage **106**, ROM **116** or RAM **118**, including an operating system **122**, one or more applications programs **124**, program data **126**, and other program modules **128**. A user may enter commands and information into the hardware device **100** through data entry module **108**. Data entry module **108** may include mechanisms such as a keyboard, a touch screen, a pointing device, etc. Other external input devices (not shown) are connected to the hardware device **100** via external data entry interface **130**. By way of example and not limitation, external input devices may include a microphone, joystick, game pad, satellite dish, scanner, or the like. In some embodiments, external input devices may include video or audio input devices such as a video camera, a still camera, etc. Data entry module **108** may be configured to receive input from one or more users of device **100** and to deliver such input to processing unit **102** and/or memory **104** via bus **114**.

A display **132** is also connected to the bus **114** via display adapter **110**. Display **132** may be configured to display output of device **100** to one or more users. In some embodiments, a given device such as a touch screen, for example, may function as both data entry module **108** and display **132**. External display devices may also be connected to the bus **114** via external display interface **134**. Other peripheral output devices, not shown, such as speakers and printers, may be connected to the hardware device **100**.

The hardware device **100** may operate in a networked environment using logical connections to one or more remote nodes (not shown) via communication interface **112**. The remote node may be another computer, a server, a router, a peer device or other common network node, and typically includes many or all of the elements described above relative to the hardware device **100**. The communication interface **112** may interface with a wireless network and/or a wired network. Examples of wireless networks include, for example, a BLUETOOTH network, a wireless personal area network, a wireless 802.11 local area network (LAN), and/or wireless telephony network (e.g., a cellular, PCS, or GSM network). Examples of wired networks include, for example, a LAN, a fiber optic network, a wired personal area network, a telephony network, and/or a wide area network (WAN). Such networking environments are commonplace in intranets, the Internet, offices, enterprise-wide computer networks and the like. In some embodiments, communication interface **112** may include logic configured to support direct memory access (DMA) transfers between memory **104** and other devices.

In a networked environment, program modules depicted relative to the hardware device **100**, or portions thereof, may be stored in a remote storage device, such as, for example, on a server. It will be appreciated that other hardware and/or software to establish a communications link between the hardware device **100** and other devices may be used.

It should be understood that the arrangement of hardware device **100** illustrated in FIG. **1** is but one possible implementation and that other arrangements are possible. It should also be understood that the various system components (and means) defined by the claims, described below, and illustrated in the various block diagrams represent logical components that are configured to perform the functionality described herein. For example, one or more of these system components (and means) can be realized, in whole or in part, by at least some of the components illustrated in the arrangement of hardware device **100**. In addition, while at least one of these components are implemented at least partially as an electronic hardware component, and therefore constitutes a machine, the other components may be implemented in software, hardware, or a combination of software and hardware. More particularly, at least one component defined by the claims is implemented at least partially as an electronic hardware component, such as an instruction execution machine (e.g., a processor-based or processor-containing machine) and/or as specialized circuits or circuitry (e.g., discrete logic gates interconnected to perform a specialized function), such as those illustrated in FIG. **1**. Other components may be implemented in software, hardware, or a combination of software and hardware. Moreover, some or all of these other components may be combined, some may be omitted altogether, and additional components can be added while still achieving the functionality described herein. Thus, the subject matter described herein can be embodied in many different variations, and all such variations are contemplated to be within the scope of what is claimed.

In the description that follows, the subject matter will be described with reference to acts and symbolic representations of operations that are performed by one or more devices, unless indicated otherwise. As such, it will be understood that such acts and operations, which are at times referred to as

being computer-executed, include the manipulation by the processing unit of data in a structured form. This manipulation transforms the data or maintains it at locations in the memory system of the computer, which reconfigures or otherwise alters the operation of the device in a manner well understood by those skilled in the art. The data structures where data is maintained are physical locations of the memory that have particular properties defined by the format of the data. However, while the subject matter is being described in the foregoing context, it is not meant to be limiting as those of skill in the art will appreciate that various of the acts and operation described hereinafter may also be implemented in hardware.

To facilitate an understanding of the subject matter described below, many aspects are described in terms of sequences of actions. At least one of these aspects defined by the claims is performed by an electronic hardware component. For example, it will be recognized that the various actions can be performed by specialized circuits or circuitry, by program instructions being executed by one or more processors, or by a combination of both. The description herein of any sequence of actions is not intended to imply that the specific order described for performing that sequence must be followed. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context.

Referring now to FIG. **2**, a flow diagram is presented illustrating a method **200** for building a search service application according to an exemplary embodiment. FIG. **3** is a block diagram illustrating an exemplary system for building a search service application according to embodiments of the subject matter described herein. The method **200** illustrated in FIG. **2** can be carried out by, for example, at least some of the components in the exemplary arrangement of components illustrated in FIG. **3**. The arrangement of components in FIG. **3** may be implemented by some or all of the components of the hardware device **100** of FIG. **1**.

FIG. **3** illustrates components that are configured to operate within an execution environment hosted by a computer device and/or multiple computer devices, as in a distributed execution environment. For example, FIG. **4** illustrates a plurality of computer devices **400***a*, **400***b*, **402** communicatively coupled to one another via a network **404**, such as the Internet, where an application server **402** can be configured to provide an execution environment configured to support the operation of the components illustrated in FIG. **3** and/or their analogs. Exemplary computer devices can include physical or virtual desktop computers, servers, networking devices, notebook computers, PDAs, mobile phones, digital image capture devices, and the like.

According to an embodiment, the application server **402** can also be configured to host a content management system **403**. FIG. **5** is a block diagram illustrating an exemplary content management system **403** according to an embodiment. In an embodiment, the content management system **403** can include one or more case management applications **510**, a search engine **520**, and a content classification engine **530**. In an embodiment, the search engine **520** and/or the content classification engine **530** can be independent components that are external to the case management system **403** and/or can be hosted by separate computer devices communicatively coupled to the application server **402** via the network **404**.

The case management application **510** can be configured to collect and manage information relating to a business process, such as, for example, a loan application process, an insurance claim process, and the like. The case management application **510**, in an embodiment, can include configuration information **512** that defines tasks and objects **514** associated with the business process. Each object **514** can be associated with a plurality of attributes **515**. For example, for an insurance claim process, an object **514** can represent a customer and its attributes **515** can include the customer's first name and the customer's last name. Other objects **514** can represent documents, files, folders, and the like.

During runtime, a task manager component **516** in the case management application **510** can manage the business process by distributing tasks **405** to task workers **400***a* and knowledge workers **400***b*. When the task **405** is directed to collecting information, e.g., documents or forms, the task worker **400***a* can perform the task and transmit the information **406** back to the case management application **510**. A content manager component **518** in the case management application **510** can be configured to receive the information **406** and to store it in a backend data store **450**. The backend data store **450** can include several types of backend storage structures **452***a*-**452***c*, such as a file storage system, a relational database, an XML database, and the like.

Alternatively or in addition, in an embodiment, the content manager **518** can transmit the collected information **406** to the search engine **520** and/or to the content classification engine **530** for processing. According to an embodiment, the search engine **520** can include an index manager **522** that manages, e.g., creates and updates, a plurality of search indexes **524** pertaining to a plurality of data records **460**. In an embodiment, the data records **460** include information relating to the objects **514** associated with the business process. When new or updated information **406** is received, the index manager **522** can update the appropriate search indexes **524**. In addition or alternatively, when needed, the content classification engine **530** can be configured to semantically analyze the content of the information **406** in order to classify and categorize the information. The content classification engine **530** can be configured, in an embodiment, to create content metadata, which can then be used by the search engine **520** to update and/or create search indexes **524**. In an embodiment, the data records **460** can be stored in an appropriate data structure **452***a*-**452***c* in the backend data store **450**.

With reference to FIG. **2**, in block **202**, a request to build a search service application for a first object of a plurality of objects is received, where each object is associated with a plurality of attributes and where each of the plurality of attributes is associated with a value. According to an embodiment, FIG. **3** illustrates a search service application builder component **320** in an application design engine **300** that is configured to receive a request to build a search service application for a first object of a plurality of objects. FIG. **5** illustrates that the application design engine **300** can be integrated within the content management system **403** which includes components adapted for operating in an execution environment **502**. The execution environment **502**, or an analog, can be provided by a computer device such as the application server **402**. Alternatively, the application design engine **300** can operate separately from the case management system **403**, as shown in FIG. **4**, or in another computer device communicatively coupled to the content management system **403**.

According to an embodiment, an enterprise's business expert **440** and/or case management administrator can be responsible for configuring a case management application **510**. For example, the business expert **440** can define the objects **514**, e.g., business objects, content objects, task objects, and the like, and object attributes **515** associated with the objects **514**. In addition, the business expert **440** can be

responsible for building applications, such as search service applications **600**, that are used by the case management application **510**. According to an embodiment, the business expert **440** can submit the request to build a search service application **600** directly to the search service application builder component **320**. Alternatively, the request can be submitted to the case management application **510**, which can be configured to route the request to the search service application builder component **320** in the application design engine **300**. In an embodiment, the request received by the search service application builder component **320** can include information identifying the first object **514**.

The case management application **510** can be configured to receive the request to build the search service application via a network subsystem **503** and an application protocol layer, or other higher protocol layer, as illustrated by an exemplary HTTP protocol layer **504**, among many possible standard and proprietary protocol layers. These higher protocol layers can encode, package, and/or reformat data for sending and receiving messages over a network layer, such as Internet Protocol (IP), and/or a transport layer, such as Transmission Control Protocol (TCP) and/or User Datagram Protocol (UDP). A command handler component **507** in the case management system **403** can be configured to receive the request via an incoming message handler **505** and to route the request to the case management application **510** or to the application design engine **300**.

In an embodiment, when the search service application builder component **320** in the application design engine **300** receives the request to build the search service application from the business expert **440**, it can be configured to invoke a search build model **321** that allows the business expert **440** to configure the search service application **600** through a series of build interfaces **700**. For example, the business expert **440** can specify a query type for the first object **514** via a build interface **700** that presents a plurality of query types associated with a plurality of backend storage structure types. Exemplary query types include full-text queries, real-time queries, historical queries, and task-list queries; and exemplary backend storage structure types include a relational database, a native XML database, a file system, and a real-time data store. Other query types and other storage structure types exist and are not limited to those types listed above. In an embodiment, the search service application builder component **320** can be configured to receive an indication specifying the query type via the build interface **700**.

Referring again to FIG. **2** in block **204**, a first indication selecting an end-user input field and an operator associated with the end-user input field is received. According to an embodiment, the end-user input field corresponds to a first attribute of the plurality of attributes associated with the first object. The search build model **321** in the search service application builder component **320** that can be configured, in an embodiment, to receive a first indication selecting an end-user input field and an operator.

In addition to specifying a query type, the business expert **440** can also determine which query inputs the search service application **600** will accept from an end-user. FIG. **7**A illustrates an exemplary build interface **700***a* that can be presented to the business expert **440** for selecting the end-user input field and its associated operator. As mentioned above, the request includes information identifying the first object **514** for which the search service application **600** is built. For example, in FIG. **7**A, the first object **514** is "customer." In an embodiment, the search build model **321** can be configured to retrieve the attributes **515** associated the first object, and to present them in an attribute window **702**. From here, the business expert **440** can select which attribute(s) **515** of the customer object **514** will be a query input(s) that forms a search criterion/criteria. In FIG. **7**A, the business expert **440** can select an attribute **515** by "checking" a checkbox associated with an attribute **515**. In other embodiments, the business expert **440** can "drag and drop" the attribute **515** from the attribute window **702** into a workspace window **703**.

In FIG. **7**A, the business expert **440** has selected an attribute **515***b*, "First Name," as an end-user input field **704**, and another attribute **515***c*, "Last Name," as another end-user input field **704***a*. In addition, the business expert **440** can select an operator **705**, e.g., equal (=), greater than (>), before date, etc., associated with the selected end-user input field **704**, **704***a*, which can depend on the data type of the attribute **515**. In an embodiment, when the business expert **440** finishes selecting the end-user input field(s) **704**, **704***a* and the operator(s) **705**, she can submit the first indication by selecting a submit button **706**.

Referring again to FIG. **2** in block **206**, a second indication selecting a search result output field is received. According to an embodiment, the search result output field corresponds to a second attribute of the plurality of attributes associated with the first object. In an embodiment, the search build model **321** in the search service application builder component **320** can be configured to receive the second indication selecting a search result output field.

According to an embodiment, the search build model **321** can allow the business expert **440** to determine what information the search service application **600** will return to the end-user as a search result. FIG. **7**B illustrates an exemplary build interface **700***b* that can be presented to the business expert **440** for selecting query search result outputs. In an embodiment, the object attributes **515** associated with the first object **514** are presented in the attribute window **702**. From here, the business expert **440** can select which attribute(s) **515** of the customer object **514** will be provided as a search result output(s). In FIG. **7**B, the business expert **440** has selected the first attribute **515***b*, First Name, as a search result output field **710**, another attribute **515***c*, Last Name, as another search result output field **710**, and yet another attribute **515***d*, "Occupation," as another search result output field **710**. Thus, in this example, the search result will include a customer's first name, last name and occupation.

In an embodiment, the search result can be sorted based on any of the search result output fields **710**. For example, during the search service application building process, the business expert **440** can enable sorting by selecting a box **711** associated with the search result output field **710**. In FIG. **7**B, the business expert **440** has enabled sorting by the customer's last name only. In an embodiment, when the business expert **440** finishes selecting the search result output field(s) **710**, she can submit the second indication by selecting a submit button **706**.

In addition to selecting output fields **710**, the search build model **321** can also allow the business expert **440** to select search result filtering fields to filter the search result in another embodiment. For example, in FIG. **7**B, the business expert **440** can drag and drop the Last Name attribute **515***b* from the attribute window **702** into the search result filtering field **712**, select an "equal" operator **714**, and provide a value **716** for the Last Name attribute **515***b*, e.g., Smith, to filter any search result where the customer's last name is Smith. In an embodiment, when the business expert **440** finishes selecting the search result filtering field(s) **712**, operator(s) **714**, and value(s) **716** of the search result filtering field(s) **712**, she can

submit these selections in a third indication to the search service application builder component **320** by selecting the submit button **706**.

In another embodiment, the search build model **321** can also allow the business expert **440** to select a facets field corresponding to an attribute **515** associated with the object **514** in order to group the search results by the attribute **515** corresponding to the facets field. FIG. **7**C illustrates an exemplary build interface **700***c* that can be presented to the business expert **440** for selecting facets according to an embodiment. As is shown, the business expert **440** can drag and drop the Last Name attribute **515***b* from the attribute window **702** into the facets field **722**, can select a value label **724**, and optionally can indicate how to sort the information **726** so that the search results can be grouped by the customer's last name. The business expert **440** can submit the facets field selection(s) in an indication to the search service application builder component **320** by selecting the submit button **706**.

According to an exemplary embodiment, in addition to determining end-user inputs and configuring the result set, the business expert **440** can design a user interface for the end-user, e.g., a knowledge worker **400***b*. In an embodiment, the application design engine **300** can include a user interface builder component **330** that is configured to receive a request from the business expert **440** to design an end-user interface template **331** for the search service application for the first object **514**. In response to receiving the request, the user interface builder component **330** can present a build interface **700** that allows the business expert **440** to design the end-user interface template **331**.

FIG. **7**D illustrates an exemplary build interface **700***d* that can be presented to the business expert **440** for this purpose. In an embodiment, the build interface **700***d* can include a plurality of widgets **730** from which the business expert **440** can select. For example, the widgets **730** can include navigation widgets (e.g., a content tree, a navigation menu), input widgets **730***a* (e.g., checkbox, text input), layout widgets **730***b* (e.g., column box, content area), and selection widgets (e.g., drop-down list), to name a few. According to an embodiment, the business expert **440** can select a first widget **730***a* associated with the end-user input field(s) **704** and a second widget **730***b* associated with the search result output field(s) **710**. The first and second widgets **730***a*, **730***b* define how the end-user input **704** and search result output **710** fields, respectively, will be presented to the end-user **500***b*.

In an embodiment, the business expert **440** can select the first **730***a* and second **730***b* widgets from a widget window **704** and drop it into a preview window **705** to design the end-user interface template **331**. In FIG. **7**D, the end-user input fields **704**, **704***a* selected in FIG. **7**A are associated with text input box (input) widgets **730***a* in an end-user input section **732**, and also because the query type is a full-text query, a text input box widget **730***a* is provided. In a search result section **734**, the search result output fields **710** selected in FIG. **7**B are associated with a column box (layout) widget **730***b*, and the fields **710** are arranged as columns. In addition, the facets fields **722** selected in FIG. **7**C are associated with expandable list widgets. When the business expert **440** is done selecting widgets **730** for at least the end-user input **704** and search result output **710** fields, she can submit the widget selection(s) in an indication to the user interface builder component **330** by selecting the submit button **706**. According to an embodiment, when the indication selecting at least the first **730***a* and second **730***b* widgets is received, the user interface builder component **330** can be configured to generate the end-user interface template **331**, which in an embodiment, can be provided to the end-user **400***b* when a request for information relating to the first object **514** is received from the end-user **400***b*.

Referring again to FIG. **2**, when the business expert **440** has finished configuring the search service application **600**, a code template is selected from a plurality of code templates in a code library in block **208**. In an embodiment, the selected template includes code for creating a search model of a search service application. According to an embodiment, the search build model **321** can be configured to select a code template **342***b* that is designed to create a search model of a search service application **600**.

In an embodiment, the application design engine **300** can include a code library **340**, which includes a plurality of code templates **342**. Each template **342** includes code and metadata that can be loaded into extensible tools, e.g., an Integrated Development Environment (IDE), to automate the development of a family of software products. According to an embodiment, each template **342** can be designed to build a family of applications, e.g., case management applications **510**, where each member of the family represents a variation of the underlying application. For example, a particular code template **342** can be used to build a family of case management applications **510**, which includes applications representing a loan approval process, a loan refinance process and a loan restructure process.

In an embodiment, the code library **340** can be a software factory repository and the code templates **342** can be software factory templates. Each software factory template **342** can be associated with a software factory schema (not shown) that defines a particular family of applications. A more detailed discussion of software factories and software factory templates **342** is provided in "Software Factories: Assembling Applications with Patterns, Models, Frameworks and Tools," by Jack Greenfield and Keith Short (2004).

According to an embodiment, the selected template **342***b* can include code for creating a particular type of search model for the first object **514**. For example, as mentioned above, when configuring the search service application **600**, the business expert **440** can specify the type of search query the search service application **600** will generate for the first object **514**. In an embodiment, the specified query type can be associated with a particular backend storage structure **452***a*-**452***c*, and therefore the generated search query will be compatible with the backend storage structure **452***a*-**452***c*. For example, when the backend storage structure is a relational database **452***a*, the generated search query will be formatted as an SQL or DQL query. Accordingly, the selection of the template **342***b* can be based on the specified query type so that the created search model is configured to generate a search query that is compatible with the backend storage structure associated with the specified query type.

Referring again to FIG. **2** in block **210**, using the selected template **342***b*, a search model representing the search service application for the first object is generated based at least on the end-user input field **704** and the search result output field **710**. In an embodiment, the search model includes a plurality of software components for retrieving information relating to the first object **514** from a backend data store **450**. The search service application builder **320** can include an application builder tool **322** configured to generate the search model based at least on the end-user input field **704** and the search result output field **710**, and using the selected template **342***b* according to an exemplary embodiment.

In an embodiment, the application builder tool **322** can be configured to receive the template **342***b* from the library **340** and the business expert's selections provided via the build

interfaces **700** from the search build model **321**. The application builder tool **322** can then generate the software components of the search model by integrating the selections, including the end-user inputs **704** and the search result outputs **710**, with the code template **342***b*.

FIG. **6** is a block diagram illustrating an exemplary search model **610** representing a search service application **600** for the first object **514** according to an embodiment. The search model **610** includes a plurality of software components **620** that are configured to support services performed by the search service application **600** during an information retrieval process. For example, the search model **610** can include a search query generator component **620***a*, a search result generator component **620***b*, and a user interface (UI) generator component **620***c*.

In an embodiment, the code template **342***b* provides the underlying programming code associated with each of the components **620**, which can be customized by the business expert's selections. For example, the search query generator component **620***a* can be configured to generate a search query **622** using a search query model **621** that includes at least the end-user input field **704** and the search result output field **710**. In an embodiment, when a query type has been specified, the search query model **621** can be associated with the specified query type so that the search query **622** generated is compatible with the backend storage structure.

In an embodiment, the search result generator component **620***b* can be configured to generate a search result **632** that includes information requested by an end-user **400***b*. In addition, the search result generator component **620***b* can be configured to filter the information based on the value **716** of the selected search result filtering field **712**, and/or to group the information based on the selected facets field(s) **722**. Moreover, the UI generator component **620***c* can be configured, in an embodiment, to generate a query page **800** based on the UI template **331** designed by the business expert **440** and to provide the query page **800** to the end-user **400***b* when a request for information relating to the first object **514** is received from the end-user **400***b* and/or when the search result **632** is provided to the end-user **400***b*.

FIG. **8** illustrates an exemplary query page **800** that can be provided to the end-user **400***b* according to an embodiment. The query page **800** corresponds to the business expert's widget selections discussed above and illustrated in FIG. **7**D. As is shown, the query page **800** includes an end-user input section **802** that provides input text boxes **803** for receiving from the end-user **400***b* values for the attributes corresponding to the end-user input fields **704**, **704***a*. In an embodiment, the query page **800** also includes a search results section **804**, which provides the values of the attributes **515** corresponding to the selected result output fields **710**. In addition, the query page **800** can include a facets window **806** that can display the attributes **515** corresponding to the facets fields **722**, the groups by attribute value, and the number of records in each group.

According to an embodiment, once the application build tool **322** has generated and configured the software components **620** of the search model **610**, the application build tool **322** can be configured to compile the programming code and to prepare the search model **610** for deployment. In an embodiment, the search service application builder component **320** in the application design engine **300** can include a deployment engine **350** configured to manage the deployment of the search service application **600**.

Once deployed, the search service application **600** for the first object **514** can be managed by a search service manager component **540** in the case management system **403**. In an embodiment, the search service manager **540** can be configured to manage a plurality of search service applications **600** for a plurality of objects **514** associated with the case management application **510**.

During runtime, the search service application **600** for the first object **514** can be utilized to retrieve information relating to the first object **514** from at least one backend storage structure **452***a*, **452***b*, **452***c*. For example, as mentioned above, the task manager **516** in the case management application **510** can distribute tasks to workers **400***a*, **400***b*. While some tasks **405** can be directed to collecting information, other tasks **405***a* can be directed to making a decision. In the later case, a knowledge worker **400***b* assigned to perform such a task **405***a* may need to retrieve additional information in order to reach his decision. For example, the task **405***a* can involve making a decision whether to provide an additional insurance policy for a customer's teenage daughter, and the knowledge worker **400***b* would like to retrieve information relating to the occupation of the customer.

According to an embodiment, the knowledge worker **400***b*, i.e., the end-user, can transmit a search request **415** for information relating to a customer object, i.e., the first object **514**, to the content management system **403**. In an embodiment, the search request **415** can include information identifying the first object **415**, such as an object identifier or name. The command handler component **507** can receive the request **415** via the incoming message handler **505** and route the request **415** to the case management application **510**, which can be configured to receive the request **415**, and to invoke the search service application **600** for the first object **514**, e.g., the customer object. Alternatively, or in addition, the command handler component **507** can route the request **415** to the search service manager component **540**, which can be configured to launch the search service application **600**.

When invoked or launched, the search service application **600** can be configured to transmit the query page **800** to the knowledge worker **400***b* so that the knowledge worker **400***b* can submit to the search service application **600** the values for the attributes **515** corresponding to the end-user search input fields **704**, **704***a*. For example, in FIG. **8**, the attribute(s) **515***b*, **515***c* of the customer object **514** corresponding to the end-user input field(s) **704**, **704***a* are "First Name" and "Last Name," respectively, and the knowledge worker **400***b* can, in an embodiment, submit a customer's first and last names to the search service application **600** via the query page **800**. In addition, because the query type associated with the search service application **600** is a full-text query, the knowledge worker **400***b* can also submit at least one string as a search criterion.

In an embodiment, the search query generator component **620***a* in the search model **610** can be configured to receive the value(s) for the attribute(s) **515***b*, **515***c* corresponding to the end-user input field(s) **704**, **704***a*, and to generate a search query **622** based on the received value(s). For example, according to an embodiment, the search query generator **620***a* can use the search query model **621** to generate a search query **622** that includes a search criteria based on the values for the attributes **515***b*, **515***c* corresponding to the end-user input fields **704**, **704***a*, and that also includes the attributes **515***b*, **515***c*, **515***d* corresponding to the search result output field(s) **710**. In addition, when a query type has been specified, the search query **622** generated by the search query model **621** can be compatible with the backend storage structure associated with the query type.

According to an embodiment, the search service application **600** can be configured to invoke the search engine **520** to retrieve at least one data record **460** that includes the infor-

mation requested by the end-user. For example, the search query **622** can be provided to the search engine **502**, which can be configured to process the search query **622** against the appropriate backend storage structure, e.g., **452***a*, and to locate data records **460** related to the first object **514** that include the requested information.

In an embodiment, the search result generator component **620***b* can be configured to receive the retrieved data record(s) **460** and to generate the search result **632** based at least on the data records **460**, For example, the search result generator component **620***b* can be configured to extract the requested information from the data record **460** and to format it so that it can be included in the search results section **804** of the query page **800**. In another embodiment, the search result generator component **620***b* can be configured to filter the data records **460** based on the selected search result filtering field(s) **712**, and/or to group the data records **460** based on the selected facets field(s) **722**.

According to an embodiment, when the search result **632** is generated, the search service application **600** can be configured to provide the search result **632** to the knowledge worker/end-user **400***b*. For example, the resulting search result **632** can be provided, in an embodiment, to the UI generator **620***c* so that it can be included in the search results section **804** and in the facets window **806** of the query page **800**. In another embodiment, the knowledge worker/end-user **400***b* can include a user interface component (not shown) that can receive the search result **632** and generate a page for displaying the search result **632** to the knowledge worker. The search service application **600** can be configured, in an embodiment, to transmit the search result **632** and/or the query page **800** to the knowledge worker/end-user **400***b*. For example, the search service application **600** can be configured to provide the search result **632** and/or the query page **800** to an outgoing message handler **506** in the case management system **403**. In an embodiment, the outgoing message handler **506** can be configured to build a packet including the search result **632** and/or query page **800** and to interoperate directly with the protocol layer of the network subsystem **503** or with an application protocol layer, as described above and illustrated by the exemplary HTTP protocol layer **504**. The packet can be transmitted as a whole or in parts via the network subsystem **503** over the network **404** to the knowledge worker/end-user **400***b*.

According to exemplary embodiments, the business expert **440** of an enterprise can design and build a customized search service application **600** using a search build model **321** provided by an application design engine **300**. Moreover, the business expert **440** can easily modify the search service application **600** by changing the search model **610** representing the search service application **600**. In an embodiment, the business expert **440** needs little or no computer programming experience or knowledge of backend data storage structures and/or query languages to build and/or update the application **600**. A plurality of search service applications **600** can be built for a plurality of objects **514** for any or all phases of the business process lifecyle. Because the applications **600** are built using a code template **342***b*, the applications **600** can be consistent with one another and not dependent on the whims of different programming professionals. Accordingly, in an embodiment, a search-based case management application **510** can be provided in a flexible, cost-effective and time efficient manner.

The use of the terms "a" and "an" and "the" and similar referents in the context of describing the subject matter (particularly in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation, as the scope of protection sought is defined by the claims as set forth hereinafter together with any equivalents thereof entitled to. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illustrate the subject matter and does not pose a limitation on the scope of the subject matter unless otherwise claimed. The use of the term "based on" and other like phrases indicating a condition for bringing about a result, both in the claims and in the written description, is not intended to foreclose any other conditions that bring about that result. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention as claimed.

Preferred embodiments are described herein, including the best mode known to the inventor for carrying out the claimed subject matter. Of course, variations of those preferred embodiments will become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventor expects skilled artisans to employ such variations as appropriate, and the inventor intends for the claimed subject matter to be practiced otherwise than as specifically described herein. Accordingly, this claimed subject matter includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed unless otherwise indicated herein or otherwise clearly contradicted by context.

What is claimed is:

1. A system for building a search service application, the system comprising:

a processor-based search service application builder component, which when executed on a computer, will cause the processor to:

receive a request to build a search service application for a first object of a plurality of objects, wherein each object is associated with a plurality of attributes and wherein each of the plurality of attributes is associated with a value;

receive a first indication of a selection of an end-user input field and an operator associated with the end-user input field, wherein the end-user input field corresponds to a first attribute of the plurality of attributes associated with the first object;

receive a second indication of a selection of a search result output field, wherein the search result output field corresponds to a second attribute of the plurality of attributes associated with the first object;

select a code template from a plurality of code templates in a code library, the selected code template comprising programming code for creating a search model of a search service application; and

generate a search model representing the search service application for the first object using the selected code template, and based at least on the end-user input field and the search result output field, wherein the search model includes a plurality of software components for retrieving information relating to the first object from a backend data store.

2. The system of claim 1 wherein the processor-based search service application builder component, when executed will further cause the processor to receive a third indication specifying a query type for the first object, wherein the specified query type is associated with one of a plurality of backend storage structure types and wherein the query type is one of a full-text query, a real-time query, a historical query, and a task-list query.

3. The system of claim 2 wherein the selected code template comprises programming code for creating a search model corresponding to the specified query type and wherein the search model includes a software component configured to generate a search query that is compatible with the backend storage structure type associated with the specified query type.

4. The system of claim 1 wherein the search model includes at least one software component configured to:

receive from an end-user a request for information relating to the first object and a value for the first attribute corresponding to the end-user input field;

generate a search query including a search criterion based on the value for the first attribute corresponding to the end-user input field, and including the second attribute corresponding to the search result output field;

retrieve at least one data record of a plurality of data records relating to the first object, wherein the at least one retrieved data record includes the information requested by the end-user;

generate a search result based at least on the at least one retrieved data record; and

provide the search result to the end-user.

5. The system of claim 4 wherein the processor-based search service application builder component is further configured for receiving a third indication of a selection of a search result filtering field corresponding to an attribute of the plurality of attributes associated with the first object, the third indication also selecting an operator for the attribute corresponding to the search result filtering field, and identifying a value for the attribute corresponding to the search result filtering field.

6. The system of claim 5 wherein the search model includes a software component configured for generating the search result by filtering the at least one retrieved data record based on the value for the attribute corresponding to the selected search result filtering field.

7. The system of claim 4 wherein the processor-based search service application builder component, when executed will further cause the processor to receive a third indication selecting a facets field corresponding to an attribute of the plurality of attributes associated with the first object.

8. The system of claim 7 wherein the search model includes a software component configured for generating the search result by grouping the at least one retrieved data object by the attribute corresponding to the facets field.

9. The system of claim 1 wherein the processor-based search service application builder component, when executed will further cause the processor to:

receive a request to design an end-user interface template for the search model representing the search service application for the first object;

receive a third indication of a selection of a first widget and a second widget from a plurality of widgets, wherein the selected first widget is associated with the end-user input field and the selected second widget is associated with the search result output field; and

generate the user interface template for the search model for the first object, wherein the search model representing the search service application includes at least one software component configured for providing the user interface template to an end-user when a request for information relating to the first object is received from the end-user.

10. The system of claim 1 further comprising a processor-based case management application for a business process executed on the computer, the case management application comprising configuration information defining the plurality of objects including the first object for the business process, and configured for receiving a request for information relating to the first object from an end-user, and for invoking the search service application for the first object in response to receiving the request.

11. A computer program product comprising computer-readable program code to be executed by one or more processors when retrieved from a non-transitory computer-readable medium, the program code including instructions to:

receive a request to build a search service application for a first object of a plurality of objects, wherein each object is associated with a plurality of attributes and wherein each of the plurality of attributes is associated with a value;

receive a first indication of a selection of an end-user input field, wherein the end-user input field corresponds to a first attribute of the plurality of attributes associated with the first object;

receive a second indication of a selection of a search result output field, wherein the search result output field corresponds to a second attribute of the plurality of attributes associated with the first object;

select a code template from a plurality of code templates in a code library, the selected code template comprising programming code for creating a search model of a search service application; and

generate the search model representing the search service application for the first object using the selected code template, and based at least on the end-user input field and the search result output field, wherein the search model includes a plurality of software components for retrieving information relating to the first object from a backend data store.

12. A method for building an application, the method comprising:

receiving, by a server, a request to build a search service application for a first object of a plurality of objects, wherein each object is associated with a plurality of attributes and wherein each of the plurality of attributes is associated with a value;

receiving, by the server, a first indication of a selection of an end-user input field, wherein the end-user input field corresponds to a first attribute of the plurality of attributes associated with the first object;

receiving, by the server, a second indication of a selection of a search result output field, wherein the search result output field corresponds to at least one of the first attribute and a second attribute of the plurality of attributes associated with the first object;

selecting, by the server, a code template from a plurality of code templates in a code library, the selected code template comprising programming code for creating a search model of a search service application; and

generating, by the server, the search model representing the search service application for the first object using the selected code template, and based at least on the end-user input field and the search result output field, wherein the search model includes a plurality of soft-

ware components for retrieving information relating to the first object from a backend data store.

13. The method of claim **12** further comprising:

receiving, by the server, a third indication specifying a query type for the first object, wherein the specified query type is associated with one of a plurality of back-end storage structure types and wherein the query type is of one of a full-text query, a real-time query, a historical query, and a task-list query.

14. The method of claim **13** wherein the selected code template comprises programming code for creating a search model corresponding to the specified query type, and wherein the search model includes a software component configured to generate a search query that is compatible with the backend storage structure type associated with the specified query type.

15. The method of claim **12** further comprising:

receiving, by the server, a request from an end-user for information relating to the first object, and a value for the first attribute corresponding to the end-user input field;

generating, by the server, a search query including a search criterion based on the value for the first attribute corresponding to the end-user input field;

retrieving at least one data record of a plurality of data records relating to the first object, wherein the at least one retrieved data record includes the information requested by the end-user;

generating a search result based at least on the at least one retrieved data record; and

providing the search result to the end-user.

16. The method of claim **15** further comprising receiving, by the server, a third indication of a selection of a search result filtering field corresponding to an attribute of the plurality of attributes associated with the first object, the third indication also selecting an operator for the attribute corresponding to the search result filtering field, and identifying a value for the attribute corresponding to the search result filtering field.

17. The method of claim **16** wherein generating the search result includes filtering the at least one retrieved data record based on the value for the attribute corresponding to the selected search result filtering field.

18. The method of claim **15** further comprising receiving, by the server, a third indication selecting a facets field corresponding to an attribute of the plurality of attributes associated with the first object, wherein generating the search result includes grouping the at least one retrieved data object by the attribute corresponding to the facets field.

19. The method of claim **12** further comprising:

receiving, by the server, a request to design an end-user interface template for the search model representing the search service application for the first object;

receiving, by the server, a third indication selecting a first widget and a second widget from a plurality of widgets, wherein the selected first widget is associated with the end-user input field and the selected second widget is associated with the search result output field;

generating, by the server, the user interface template for the search model for the first object using the second code template; and

providing the user interface template to an end-user when a request for information relating to the first object is received from the end-user.

20. The method of claim **12** further comprising:

providing, by the server, a case management application for a business process, the case management application comprising configuration information defining the plurality of objects including the first object for the business process;

receiving, by the case management application, a request for information relating to the first object from an end-user;

invoking, by the case management application, the search service application for the first object in response to receiving the request; and

transmitting the request for information from the end-user to the search service application for the first object.

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